The official voice of the Air Force Research Laboratory
news@afrl
Features
Summer 2000 Volume II, Issue 2

Test examines atmosphere effects on laser beam

by Rich Garcia, Directed Energy Directorate

KIRTLAND AFB, N.M. — To the casual observer, it seemed easy enough: Take an Air Force plane and use it to find out what the atmosphere would do to a beam of laser light fired over a long distance.

That plane has just returned and the job was more involved than it sounded. It took 54 people from nine organizations, a month and a half away from Kirtland AFB, more than 150 flying hours over six countries, and operating two very sophisticated sensors.

Officials at the Air Force Research Laboratory's Directed Energy Directorate expressed satisfaction with the test series. The collected data thus far indicates that the effects of the atmosphere will not adversely affect a laser beam more than anticipated. This is welcome news for the Airborne Laser – a jumbo jet that will carry a laser capable of destroying missiles from hundreds of miles away. This means the warbird's laser will not be hampered by the atmosphere over the ranges for which it is designed.

TWO HEADS ARE BETTER THAN ONE — Major Kim McCrae (left), chief of the Airborne Laser Tech Branch, and Capt. Jason Gale, chief of Systems Engineering, check the alignment of optics on a stellar scintillometer. The scintillometer focuses on individual stars, processing the light from those stars . Information from this sophisticated sensor helps to determine to what extent the atmosphere might distort.

At the heart of the tests were two unusual instrumented systems: a stellar scintillometer and an anemometer. Both of these sensors were needed to gather the accurate data needed.

"Flying at altitudes between 39,000 and 47,000 feet, we used the scintillometer to focus on individual stars," said 1st Lt. Dawn Grover, the test program manager. "The scintillometer processed the returning light from those stars to help determine to what extent the atmosphere might distort a beam of laser light."

According to 1st Lt. Patrick Kelly, a flight test engineer on the program, the second piece of equipment — an anemometer — collected "outside" information at the rate of 6,000 samples per second. "Its most distinctive feature," said Kelly, "is a set of four-pronged wires, about the thickness of a human hair, that protrude from a housing beneath the nose of the aircraft. These sensors measure the temperature and velocity of the air through which the plane is flying. Incredibly sensitive, this sensor can detect temperatures to within 1/1000th of a degree while the plane flies 475 miles per hour."

Although the plane spent time in Alaska, England, Japan and Singapore, the majority of testing took place in Doha, Qatar, in the Middle East, and in the Republic of Korea's Osan Air Base in the Far East. This was the third of three data-collecting campaigns in these areas. Each trip has been at a different time of the year, to see how the data might vary during different seasons.

The test plane, a modified Air Force C-135E aircraft named Argus, is owned and flown by a crew from Detachment 2 of the 452nd Flight Test Squadron at Kirtland AFB. Management of the aircraft and the test programs it supports comes under AFRL's Active Remote Sensing Branch.

Among the other organizations that provided support were a team of security policemen from the 610th Security Forces Squadron at Carswell Naval Air Station, Texas, and balloon specialists from AFRL at Hanscom AFB, Mass. This last group also gathered atmospheric data, but from sensors carried aloft by large, high-altitude balloons. The aircraft-gathered data and the balloon-gathered data were combined and compared for more precise, in depth information on atmospheric conditions.

Argus is a specially-instrumented C-135E aircraft, designed as a flying laboratory to gather a wide variety of data. It carries electro-optical sensors that can be tuned to gather technical information across the light spectrum (visible, ultraviolet, and long-wave infrared). Its sensors can collect radiometric imagery, spectroscopic data, and measure atmospheric turbulence. Airborne light detection and ranging systems can be installed for remote sensing of the atmosphere. The aircraft can be adapted for any flying experiment up to 20,000 pounds.

Wayne Wasson, Argus program manager, emphasized that the aircraft can operate at up to 50,000-foot altitudes for 12 hours at a time. "We use Global Positioning System satellites and an Inertial Navigation System to assure precise navigation and timing," Wasson said.

"Over the past few years," Wasson said, "we conducted a variety of experiments: one used a laser beam to scan an area, sensing for environmental contaminants in the air. Another project assessed a communications device that relayed information to a battlefield commander via satellite. Yet others examined plume phenomenology – that is, information about a missile from its exhaust trail." **@**